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ФИО: Ястребов Олег Александрович
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**PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
NAMED AFTER PATRICE LUMUMBA**

Institute of Environmental Engineering

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

Современные методы и технологии защиты окружающей среды / Modern methods and technologies of environmental protection

(наименование дисциплины/модуля)

Recommended by the Methodological Council for the Education Field:

05.04.06 Ecology and nature management

(код и наименование направления подготовки/специальности)

The discipline is mastered within the framework of the main professional higher education program:

УПРАВЛЕНИЕ ПРИРОДОПОЛЬЗОВАНИЕМ / NATURE MANAGEMENT

(наименование (профиль/специализация) ОП ВО)

1. COURSE GOALS

The course goal is to familiarization with modern technologies of protection of the atmosphere, water bodies, soil and land resources and technologies of waste management of production and consumption. The issues of environmental and economic efficiency of technologies, their comparative assessment and selection of the best available technologies are considered.

2. LEARNING OUTCOMES

The mastering of the discipline "Современные методы и технологии защиты окружающей среды / Modern methods and technologies of environmental protection" is aimed at the formation of the following competencies (parts of competencies) in students:

Table 2.1. List of competencies formed by students during the development of the discipline (LEARNING OUTCOMES)

Code	Competence	Indicators of competence achievement (within the framework of this discipline)
ПК-1 SPC-1	Способность формулировать проблемы, задачи и методы научного исследования, обобщать полученные результаты, формулировать выводы и практические рекомендации на основе результатов исследований The ability to formulate problems, tasks and methods of scientific research, summarize the results obtained, formulate conclusions and practical recommendations based on research results	ПК-1.1 Знает основы методологии планирования исследований SPC-1.1 Knows the basics of research planning methodology
		ПК-1.2 Умеет обобщать полученные результаты, формулировать выводы и практические рекомендации на основе результатов исследований SPC-1.2 He is able to summarize the results obtained, formulate conclusions and practical recommendations based on the results of research
ПК-5 SPC-5	Способен разрабатывать типовые природоохранные мероприятия и проводить оценку воздействия планируемых сооружений или иных форм хозяйственной деятельности на окружающую среду Is able to develop standard environmental protection measures and assess the impact of planned structures or other forms of economic activity on the environment	ПК-5.1 Способен разрабатывать и планировать внедрение типовых природоохранных мероприятий с учетом международной практики и требований национального законодательства SPC-5.1 Is able to develop and plan the implementation of standard environmental measures taking into account international practice and the requirements of national legislation
ПК-6 SPC-6	Способен диагностировать проблемы охраны природы, разрабатывать практические рекомендации по ее охране и	ПК-6.1 Способен выявлять несоответствия состояния компонентов окружающей среды требованиям национальных и международных стандартов

	обеспечению устойчивого развития Able to diagnose problems of nature protection, develop practical recommendations for its protection and sustainable development	SPC-6.1 It is able to detect inconsistencies in the state of environmental components with the requirements of national and international standards
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3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The discipline "Современные методы и технологии защиты окружающей среды / Modern methods and technologies of environmental protection" refers to Compulsory Disciplines of the Higher Education Program.

Within the framework of the higher education program, students also master other disciplines and/or practices that contribute to expected learning outcomes of the discipline "Современные методы и технологии защиты окружающей среды / Modern methods and technologies of environmental protection".

Table 3.1. List of Higher Education Program components that contribute to expected learning outcomes

Code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
ПК-1 SPC-1	Способность формулировать проблемы, задачи и методы научного исследования, обобщать полученные результаты, формулировать выводы и практические рекомендации на основе результатов исследований The ability to formulate problems, tasks and methods of scientific research, summarize the results obtained, formulate conclusions and practical recommendations based on research results		Методология научного творчества / Methodology of scientific creativity HSE менеджмент / HSE-management Экологическое проектирование промышленных объектов / Environmental design of industrial facilities Комплексная оценка природных и производственных потенциалов территорий / Comprehensive assessment of natural and industrial potentials of territories Информационные технологии в природопользовании / Information technologies in nature management Научно-исследовательская работа в семестре, включая курсовые работы / Research work in the semester, including term papers Производственная практика / Production practice
ПК-5 SPC-5	Способен разрабатывать типовые природоохранные мероприятия и проводить оценку воздействия		Сертификация сырья, производственных процессов и продукции по международным экологическим требованиям / Certification of raw materials, production processes and products in

Code	Competence	Previous Disciplines (Modules)	Subsequent Disciplines (Modules)
	<p>планируемых сооружений или иных форм хозяйственной деятельности на окружающую среду Is able to develop standard environmental protection measures and assess the impact of planned structures or other forms of economic activity on the environment</p>		<p>accordance with international environmental requirements Радиоэкологическая безопасность территорий / Radioecological safety of territories HSE менеджмент / HSE-management Экологическое проектирование промышленных объектов / Environmental design of industrial facilities Хранение, переработка и утилизация отходов / Storage, processing and disposal of waste Дисциплины по выбору Б1.В.ДВ.4 Международные стандарты управления качеством окружающей среды / International Environmental Quality Management Standards Управление минерально-сырьевым комплексом / Management of the mineral resource complex</p>
ПК-6 SPC-6	<p>Способен диагностировать проблемы охраны природы, разрабатывать практические рекомендации по ее охране и обеспечению устойчивого развития Able to diagnose problems of nature protection, develop practical recommendations for its protection and sustainable development</p>		<p>Экологическое проектирование промышленных объектов / Environmental design of industrial facilities Комплексная оценка природных и производственных потенциалов территорий / Comprehensive assessment of natural and industrial potentials of territories Методы мониторинга экологической безопасности природопользования / Methods of monitoring environmental safety of nature management / Methods of monitoring environmental safety of nature management / Methods of monitoring environmental safety of nature management Мониторинг природно-техногенных систем / Monitoring of natural and man-made systems Производственная практика / Production practice Преддипломная практика</p>

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

Workload of the course «Современные методы и технологии защиты окружающей среды / Modern methods and technologies of environmental protection» is 4 ECTS.

Table 4.1. Types of academic activities during the period of the HE program mastering

Вид учебной работы	TOTAL	Semesters			
		1	2	3	4
Contact academic hours	51	51			
Incl.:					
Lectures	17	17			
Lab work					
Seminars	34	34			
Self-study	66	66			
Evaluation and assessment	27	27			
Total workload	Ac.hours	144	144		
	ECTS	4	4		

5. COURSE CONTENTS

Table 5.1. The content of the discipline (module) by type of academic work

Name of the discipline section	Content of the section (topics)	Type of academic activity*
Environmental hazard of waste. The concept of ecosystem sustainability. Cycle of substances and elements	Features of interaction of xenobiotics with adiabatic components of the environment. Features of the impact of pollutants on living organisms. Environmental, physicochemical and toxicological features of priority persistent organic pollutants (POPs). The cycle and biogeochemical cycles: carbon, nitrogen, sulfur, phosphorus, metals.	Lectures, Seminars
Self-cleaning ability of ecosystems. Parameters of ecosystem sustainability	The principles of the existence of ecosystems. Homeostasis. Types of resilience. The cycle of substances and elements. Self-cleaning ability of ecosystems. Abiotic self-purification processes. Biotic self-purification processes. Soil microbiocenosis. Microbiocenosis of water bodies. Microflora of the air. The degree and speed of self-cleaning. Assimilation capacity of the ecosystem.	Lectures, Seminars
Wastewater & Sewage Treatment. Sediments of Wastewater	The main sources of wastewater. Composition and Sources of Wastewater. Types of Wastewater Pollution (according to physic and chemical properties). Atmospheric Sewage or Runoff. Household Wastewater. Modern Methods of Sewage Treatment (according to the mechanism of action). Technological Treatment Schemes	Lectures, Seminars
Gas Emissions Treatment: Modern Approaches	Classification of gas emissions based on the aggregative state. Dispersion of systems (particle sizes). Particulate matter - aerosols: dust, fumes.	Lectures, Seminars

	Methods of the air protection. Methods for cleaning of gas & dust emissions from aerosols. "Wet" cleaning of gas and dust emissions from aerosols	
Solid Waste Treatment Technologies: Secondary Raw Materials Recycling, Thermal Processing.	Pyramid of the waste management. Waste as the "secondary resources": recycling and "waste to energy" technologies. Norms for the assessment of the waste danger. Norms of the waste formation, accumulation, storage and processing	Lectures, Seminars
Landfilling	Sources of Industrial Solid Waste (ISW). Ecological Features of ISW. Methods of Industrial Nonradioactive Waste Elimination and Processing. Basic Methods of Municipal Waste Processing. Sorting and Using as Secondary Raw Materials. Rational MSW sorting scheme. "Dry" mechanical or Physical methods. The main technological indicators of the efficiency of separation of solid waste	Lectures, Seminars
Water Remediation Technologies	Types of water bodies. Types of pollutants of water bodies. Sources of water pollution. Water restoration methods. Stages of environmental remediation of water bodies and preparatory works: technical, biological. Creation (restoration) of the coastal ecosystem. Comprehensive improvement of the surrounding area. Examples. Purification of water objects from oil products. Reducing the concentration of pollutants in water bodies	Lectures, Seminars

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Classroom for Academic Activity Type	CLASSROOM EQUIPMENT	Specialized learning, laboratory equipment, software and materials for the mastering the course
Lecture	An auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; a board (screen) and technical means of multimedia presentations.	-
Seminars	Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, Stable wireless Internet connection. Software: Microsoft Windows, MS Office / Office 365, MS Teams, Chrome (latest stable release), Skype	-
Self-studies	An auditorium for independent work of students (can be used for seminars and consultations), equipped with a set of	-

Classroom for Academic Activity Type	CLASSROOM EQUIPMENT	Specialized learning, laboratory equipment, software and materials for the mastering the course
	specialized furniture and computers with access to an electronic information and educational environment.	

7. RECOMMENDED SOURCES FOR COURSE STUDIES

Main reading:

1. Saxena, Gaurav, R. Kishor, and R. N. Bharagava. Bioremediation of industrial waste for environmental safety. Springer Singapore, 2020..
2. Foo D. C. Y., Gopakumar S. T., Show P. L. Green Technologies: Bridging Conventional Practices and Industry 4.0. – MDPI-Multidisciplinary Digital Publishing Institute, 2020.
3. Coelho S. T. et al. (ed.). Municipal Solid Waste Energy Conversion in Developing Countries: Technologies, Best Practices, Challenges and Policy. – Elsevier, 2019.
4. Kumar S., Kalamdhad A., Ghangrekar M. M. (ed.). Sustainability in Environmental Engineering and Science: Select Proceedings of SEES 2019. – Springer, 2020.
5. Cairncross S., Feachem R. Environmental health engineering in the tropics: Water, sanitation and disease control. – Routledge, 2018.

Additional sources:

- Mihelcic J. R., Zimmerman J. B. Environmental engineering: Fundamentals, sustainability, design. – John Wiley & Sons, 2021.
- Jain S. K., Singh V. P. Engineering hydrology: an introduction to processes, analysis, and modeling. – McGraw-Hill Education, 2019.
- Salem M. A. et al. Environmental technology and a multiple approach of competitiveness //Future Business Journal. – 2020. – T. 6. – №. 1. – С. 1-14.
- Wang L. K. et al. (ed.). Integrated natural resources management. – Switzerland : Springer Nature, 2021. – T. 20.

Internet-sources:

1. Electronic library system of the RUDN and third-party electronic library systems, to which university students have access on the basis of concluded contracts:
 - electronic library system of the RUDN University <http://lib.rudn.ru/MegaPro/Web>
 - electronic library system «Университетская библиотека онлайн» <http://www.biblioclub.ru>
 - electronic library system Юрайт <http://www.biblio-online.ru>
 - electronic library system «Консультант студента» www.studentlibrary.ru
 - electronic library system «Лань» <http://e.lanbook.com/>
 - electronic library system «Троицкий мост»
2. Databases and search engines:

- electronic fund of legal and regulatory and technical documentation <http://docs.cntd.ru/>
- Yandex search engine <https://www.yandex.ru/>
- Google search engine <https://www.google.ru/>
- abstract database SCOPUS <http://www.elsevier.com/locate/scopus/>
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*Educational and methodological materials for independent work of students during the development of the discipline/ module *:*

1. A course of lectures on the discipline "Современные методы и технологии защиты окружающей среды / Modern methods and technologies of environmental protection".

* - all educational and methodological materials for independent work of students are placed in accordance with the current procedure on the discipline page in the Telecommunication educational and Information System!

8. MID-TERM ASSESSMENT AND EVALUATION TOOLKIT

Evaluation materials and a point-rating system* for assessing the level of competence formation (part of competencies) based on the results of mastering the discipline "Современные методы и технологии защиты окружающей среды / Modern methods and technologies of environmental protection" are presented in the Appendix to this Work Program of the discipline.

* - evaluation toolkit and ranking system are formed on the basis of the requirements of the relevant local regulatory act of the RUDN (regulations / order).

DEVELOPER:

Docent of the ESandPQM
Department

Position, Department

Kharlamova M.D.

Signature

Name

HEAD OF THE DEPARTMENT:

Head of the Department of
Environmental Safety and
Product Quality Management

Department

Savenkova E.V.

Signature

Name

HAED OF THE HIGHER EDUCATION PROGRAM:

Professor of the Department of
Environmental Safety and
Product Quality Management

Position, Department

Redina M.M.

Signature

Name